MOTOTRBO™

DEVELOPMENT SPECIFICATION – AUTOMATIC REGISTRATION SERVICE

VERSION 02.00

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1 Introduction

1.1 Purpose of this Document

This document provides the development guidelines for the implementation of an ARS Server for the MOTOTRBO radio system.

1.2 Scope of this Document

The MOTOTRBO subscriber has a number of data applications, such as Text Message, Telemetry and Location that require sending data messages asynchronously to a Subscriber Unit (SU). An efficient transmission of such data messages requires the SU to announce its availability. In order to reduce complexity and promote the efficient use of the air interface bandwidth, it is logical to add a single registration service that can be performed once and be used by all applications. The Automatic Registration Service (ARS) provides the common registration service. It accepts, stores, and distributes subscriber's presence information to interested data applications.

This document describes the specification of the ARS protocol and provides the architecture of the MOTOTRBO™ ARS. This includes detail on the format of the ARS protocol, as well as the functionality of the protocol commands and responses. Both the MOTOTRBO portable and mobile radios support the ARS protocol.

1.3 Assumptions

The reader of the document is assumed have the following domain knowledge:

- Principles of two-way radio communications
- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)
- Internet Protocol (IP)

The reader of the document is also assumed to have the DMR Association membership. The implementation of the AES encryption in the application is required to refer to one of the DMR Association standards called "DES/AES Encryption for DMR". Only the DMR Association members have the right to access this document.

1.4 Abbreviations and Terms

Abbreviation	Term
ACK	Acknowledgement
ARS	Automatic Registration Service
CPS	Customer Programming Software
DDMS	Device Discovery & Mobility Service
NACK	Negative Acknowledgement
NAT	Network Address Translation
SU	Subscriber Unit
RNI	Radio Network Infrastructure

1.5 Phrases and Definitions

Phrase	Definition
ARS Enabled	Enables the ARS feature. This feature allows the Subscriber Unit (SU) to register and receive query from the ARS server.
ARS Refresh Timer	Controls the periodic re-registration that the ARS client performs in order to keep the ARS registration updated between the radio and the ARS server. When this timer expires the ARS client sends a registration message. This timer restarts when the ARS client receives a registration acknowledgement from the ARS server. The duration of this timer is provided by the ARS server Acknowledgement Response.
ARS Retry Timer	Period of time the ARS client wait for subsequent ARS registration procedures. When the registration fails, this timer will start counting until a new registration procedure occurs.
Capacity Plus	A digital trunking system configuration accommodating an increased subscriber base and increased volumes of data

1.6 References

[1] MOTOTRBO Text Messaging ADK Guide

[2] MOTOTRBO Location Data ADK Guide

[3] MOTOTRBO Telemetry ADK Guide

[4] MOTOTRBO Data Services Overview

[5] MOTOTRBO Device Discovery and Mobility Service-to-Watcher Interface Protocol Specification

[6] MOTOTRBO System Planner

[7] Network Interface Service ADK Guide

2 ARS Overview

2.1 ARS Architecture

The figure below shows an architecture diagram for a simple configuration of ARS. The ARS consists of two components – a Registration Application in MOTOTRBO™ radio and an ARS Server in customer network. The ARS server is running on a device that is IP capable and can communicate with radio. The device is connected to a Radio via USB, which is called the ARS Radio. The ARS Radio is responsible for routing the IP message sent from/to the ARS Server. The transport layer between the MOTOTRBO™ radio and the ARS Server is UDP/IP.

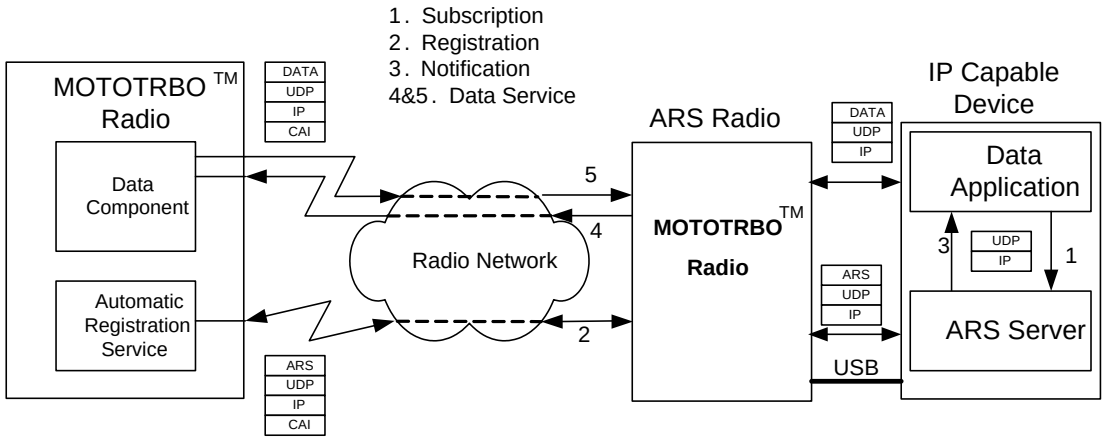

Figure 2-1 – ARS Architecture

While powering on, roaming to another site, switching to a data capable mode, and occurring periodically, the Registration application in the SU sends a registration message to the ARS Server. It also sends a Deregistration message during power off. The ARS Server saves the information received in the Registration/Deregistration message and distributes the presence information to interested data applications. Once the presence information is received, the Data Applications can start the data communication with the SU. For the MOTOTRBO™ radio, the data message can be Text Message, Telemetry, Location or any User Customized data.

When a Data Application wishes to learn about presence information of some Subscribers, it sends a SUBSCRIBE to the ARS Server. This request identifies the desired SU by its ID or any other key attribute. The ARS Server sends an immediate NOTIFY message containing the state of the SU to the Data Application.

Figure 1 is just an example of the ARS architecture. The purpose of this document is to publish the ARS protocol to a third party developer to develop their own ARS Server. This document covers the registration communication between the MOTOTRBO™ radio and the ARS Server. The developer is

responsible for implementing the communication between ARS Server and their Data Applications. Please see the reference [1], [2] and [3], in section 1.6, for more information.

2.2 Relationship between ARS Server and DDMS

The DDMS (Device Discovery and Mobility Service) is an ARS Server developed by Motorola Solutions. It is used in a MOTOTRBO™ system to monitor the presence/mobility information of ARS-capable subscriber units and report their state to interested applications. It exposes two communication interfaces, one towards the Radio Network Infrastructure (RNI), known as the SU Interface, and the other one towards the subscribing applications, known as the Watcher Interface. The SU Interface allows the DDMS to exchange ARS messages with the subscriber units over the UDP/IP protocol, while the Watcher Interface enables the communication between the DDMS and the Watcher applications over the UDP/IP and TCP/IP protocols. Its architecture is similar with what is shown in Figure 2-1.

The DDMS is a Windows-based application. If a third party application utilizes a different operating system, this ARS protocol specification allows a developer to develop their own ARS server. Note that if the developer wants to develop their own ARS server in the Windows operating system, the ARS server can co-exist with the DDMS application in condition that DDMS works in Passive Mode. For details, refer to DDMS help file. Pay attention that if MNIS (MOTOTRBO Network Interface Service) is deployed in the repeater system, the DDMS is MUST installed. MNIS is also called IP Wireline Data Gateway, it also has watcher interface. MNIS requires Motorola DDMS to receive routing parameters and uses it to send the data to the destination radio. For details, refer to [5].

The ARS Server should provide two communication interfaces:

1. Interface between Registration application in SU and ARS Server
   Upon power on, roaming to another site, switching the SU application to a data capable mode and periodically, the Registration application in SU sends a registration message to its ARS Server. It also sends a deregistration message upon power off. The ARS Server acknowledges the registration messages.
   Upon power on, the ARS Server sends a query message to a SU whose registration is not expired.

2. Interface between Data application and ARS Server
   A Data application should subscribe for the presence/absence event of all the SUs of its interest. When one of those SUs changes to presence status, the ARS Server sends a notification to the Data application.

Note: This interface is only needed when the ARS Server is designed as an individual application. The functionality of ARS may be incorporated into the third party data application, and therefore this interface is not needed.

2.3 Automatic Registration Service Procedures

This section presents the Automatic Registration Service procedures. This is accomplished via a series of scenarios presented as Message Sequence Charts.

2.3.1 SU Powers On

This scenario illustrates how a mobile subscriber registers with the ARS Server upon power on. A subscriber with Device ID of 11 is used as an example.

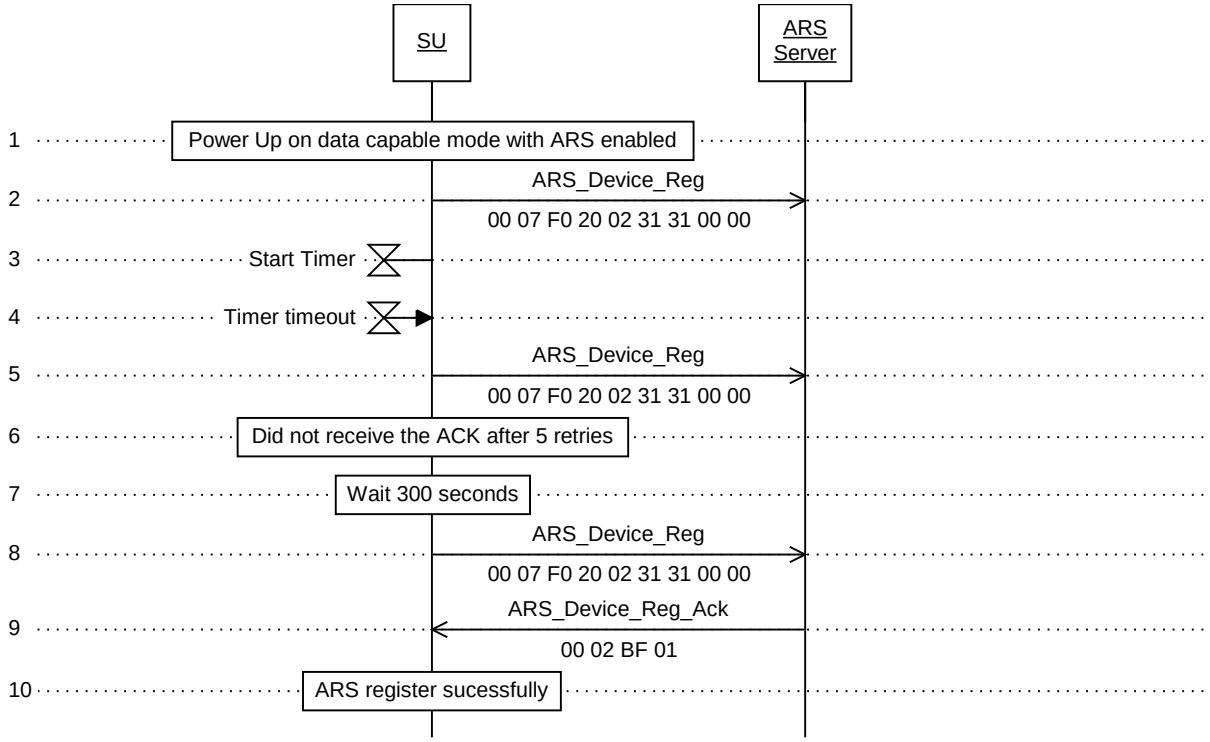

Figure 2-2 – ARS Power On

Upon power up, the SU examines the configuration of the current mode. If the SU is packet data capable and the ARS feature is enabled, the SU will form an ARS Registration message and send it to the ARS Server. To ensure it is ready for transmitting, the SU will wait random seconds (from 5 to 15) to send out the ARS Registration message after power on.

If the ARS Server does not respond within the ARS Reg Response Time, another ARS Registration Message will be formed and sent to the ARS server after random period. The random period is

between 49 seconds and 91 seconds, determined when radio power up. This will continue for 5 retries. If registration retries are exhausted, after 300 seconds, radio repeats the initial procedure.

Upon reception of the ARS Reg Response, the SU will stop the retry timer and start an ARS Refresh Timer using the value provided by the server. The purpose of this timer is to trigger a registration renewal procedure, which is used to periodically reaffirm the existence of the radio on the system to the server.

Upon reception of the ARS Registration message, the ARS Server will send back an acknowledgment message to the radio and start a SU Inactivity timer. The “SU Inactivity Time” is “Registration Refresh Time” plus a delay. The delay should be configurable in the ARS Server. The recommended value is 120 seconds. If the ARS Server fails to receive a registration message within the “SU Inactivity Time”, it shall change the status of the SU as “absent”.

2.3.2 SU Update Registration Status

This scenario illustrates how an SU periodically refreshes its registration status. This allows the ARS Server to clean up stale registration entries if necessary. A subscriber with Device ID of 11 is used as an example.

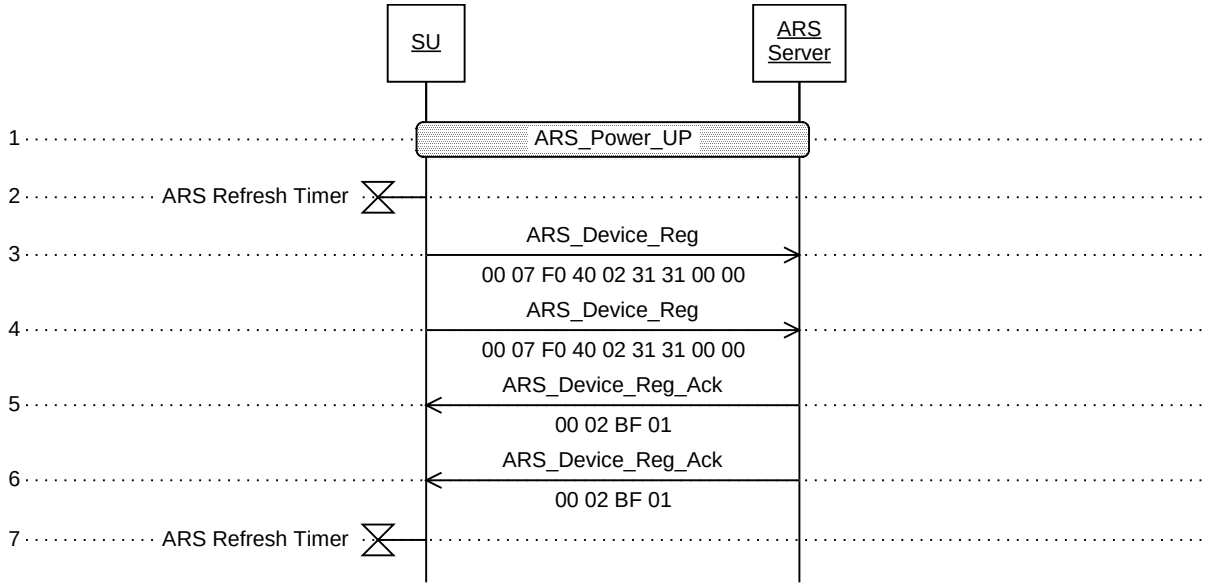

Figure 2-3 – ARS Registration Refresh

When the ARS Refresh Timer expires, the SU forms an ARS Registration message and sends it to the ARS Server to update its present state.

Upon reception of the registration message, the ARS Server will refresh the inactivity timer for the specific SU.

Upon reception of the registration response message, the SU will start the registration refresh timer.

Note: If a registration response message is not received, the registration refresh timer in the SU will expire and another registration message will be sent.

2.3.3 SU Device Deregistration

This scenario illustrates how an SU will attempt deregister from the ARS server.

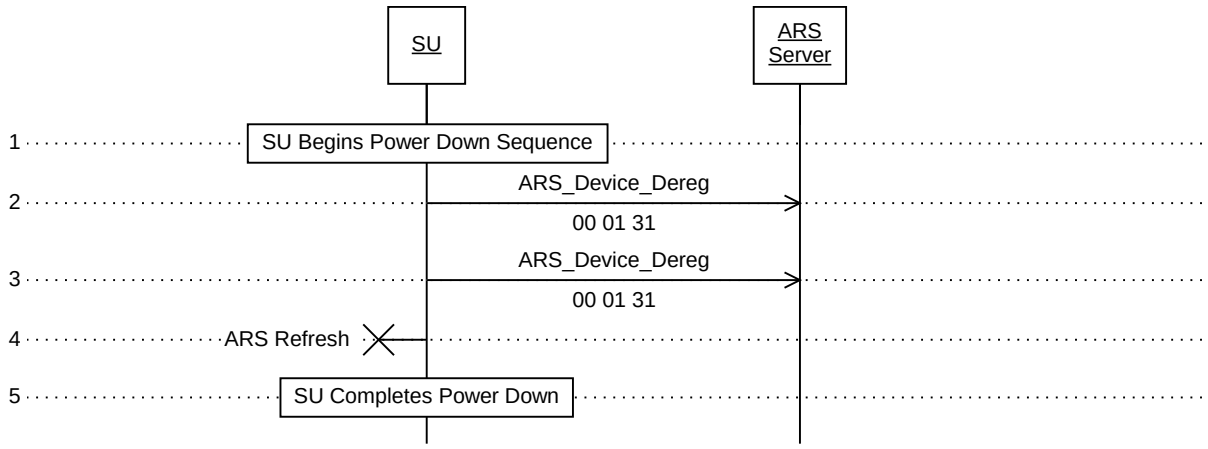

Figure 2-4 – ARS Device Deregistration

When the SU is powering down and ARS is enabled in current personality, the SU forms a deregistration message and sends to the ARS server and continues the power down sequence (no confirmation required).

Note: The Deregistration message is sent out at best effort, but not guarantee.

Upon reception of the ARS deregistration message, the ARS server shall remove the SU entry from the database.

Only on the condition when the SU is powering down on an ARS enabled personality, it will send out the ARS deregistration message. The radio will not send out the de-registration message when channel is changed or SU roam out of the site.

2.3.4 SU Query

This scenario illustrates an ARS Server querying an SU to determine if it is still within range of the system and registered with the server.

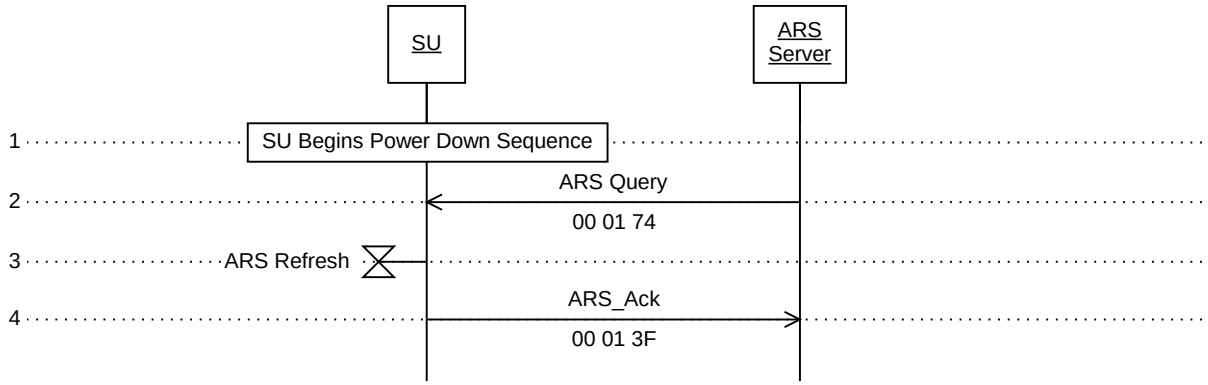

Figure 2-5 – ARS Query

Upon power on, the ARS Server shall send a query message to each SU in its database whose registration has not expired.

Upon reception of the ARS Query message, the SU shall send an acknowledgement message to the ARS Server.

The ARS Server shall set the state of a SU to “absent” if it fails to receive an ACK for the query message sent to the SU within the Response time. The Response time should be configurable and is able to be optimized in the ARS Sever. The recommended Response time is 5 seconds.

2.4 ARS Initialization Delay

With ARS enabled, when a large amount of radios power on within a short period of time, many ARS messages collide no matter the ARS messages are sent on the selected channel in the MOTOTRBO conventional system or the Enhanced GPS Revert channel in the MOTOTRBO Capacity Plus system. This impacts the system usage for voice and data call during that time.

Before MOTOTRBO R1.7, the ARS message delay is between 5 seconds to 15 seconds. This delay is not large enough for avoid collision for the case that 5 radios power up at the same time. MOTOTRBO R1.7 introduces the ARS Initialization Delay feature in the radio to randomize the delay of sending ARS registration message at power up so that different radios send out the ARS registration message at different time even though they power up at the same time. In CPS, the ARS Initialization Delay field configures the maximum value of the random delay. This configuration is radio wide. The same value shall be configured in all the radios in a system. Please see Reference [6] for more details on how to select the ARS Initialization Delay based on the number of radios, the voice profile and the system type.

With the delay of the ARS message, the application may use other messages coming from the radio as the presence indication, e.g. location update, or text message. If the application cannot tolerate the ARS message delay, it shall turn off the ARS Initialization Delay and reduce the number of the radios powering up at the same time.

2.5 ARS Message Path

The path of ARS registration message from the radio is different between the MOTOTRBO trunked system and the MOTOTRBO conventional system. In the MOTOTRBO conventional system, the ARS registration / deregistration message from the radio to the ARS server is always sent on the current selected channel no matter the GPS Revert channel or the Enhanced GPS Revert channel is selected or not. In the MOTOTRBO Capacity Plus Trunked system, the ARS registration message from the radio to the ARS server is sent on the Data Revert channel or the Enhanced GPS Revert channel depending on the current selected channel selects the Data Revert channel or the Enhanced GPS Revert channel. Due to the timing and power off sequence in the radio, the ARS deregistration message from the radio to the ARS server is always sent on the Data Revert channel no matter the current selected channel selects the Enhanced GPS Revert channel or not.

See Reference [2] for more information on Data Revert channel, the Enhanced GPS Revert channel, and the GPS Revert channel.

2.6 Sign In / Sign Out Service

The Sign In/Sign Out feature is to ask the radio user to sign in/out from a job ticket management system with his/her sign-in ID which is ASCII code. It can also indicate the current state that the user has signed into the system or not. The radio performs different behaviors in different states. E.g. Handle Job Ticket according to Signed In or Not Signed In state. The sign-in information shall be kept until radio power down or user sign out manually. The sign-in menu will only be available in digital channel when Sign In/Sign Out Enabled field checked by CPS. For CPS details, refer to section 4.2 ARS Radio ID and ARS Monitoring ID

The “ARS Radio ID” and “ARS Monitoring ID” are both ARS related fields but for different purposes. If there is only one ARS server in the system, the ARS Monitor ID shall not be set in the control station nor in any of the field radios. Configuring the ARS Monitor ID in the field radios will cause the flooding of the ARS messages in the system. For details, refer to [7].

The “ARS Radio ID” is the ID of the radio that is connected to the ARS server that the user intends to communicate with for data services.

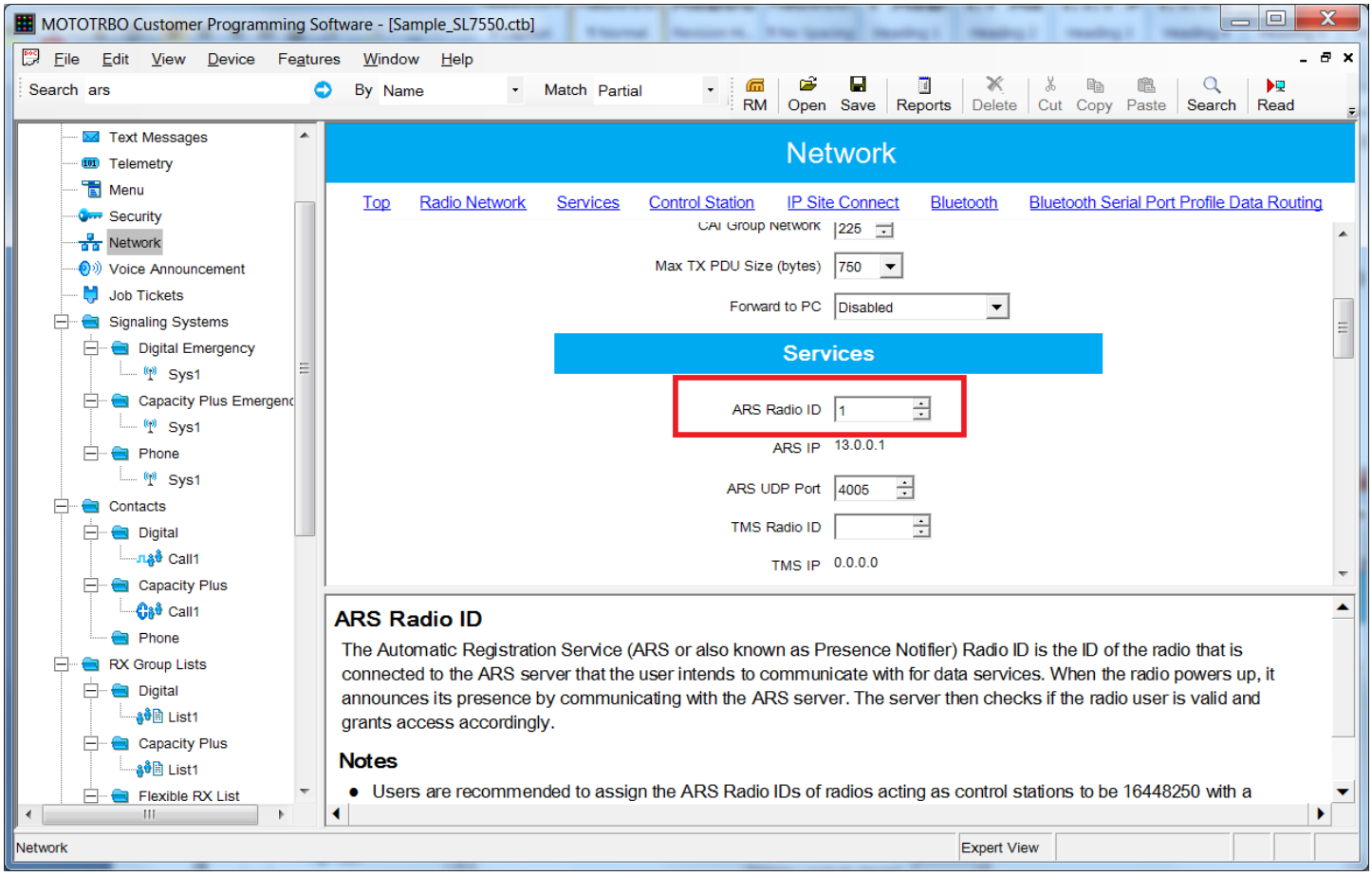

Figure 4-2 – ARS Radio ID

The “ARS Monitoring ID” is the ID of the radio that is connected to the ARS server that the user intends to communicate with for the Over-the-Air Programming (OTAP) services. If the ARS Monitor ID is configured in the control station, the control station will not send the layer 2 confirmation for the ARS message, however it will still pass the ARS message to the connected server. The connected server interfacing to the control station shall not send the layer 7 ARS message acknowledgement.

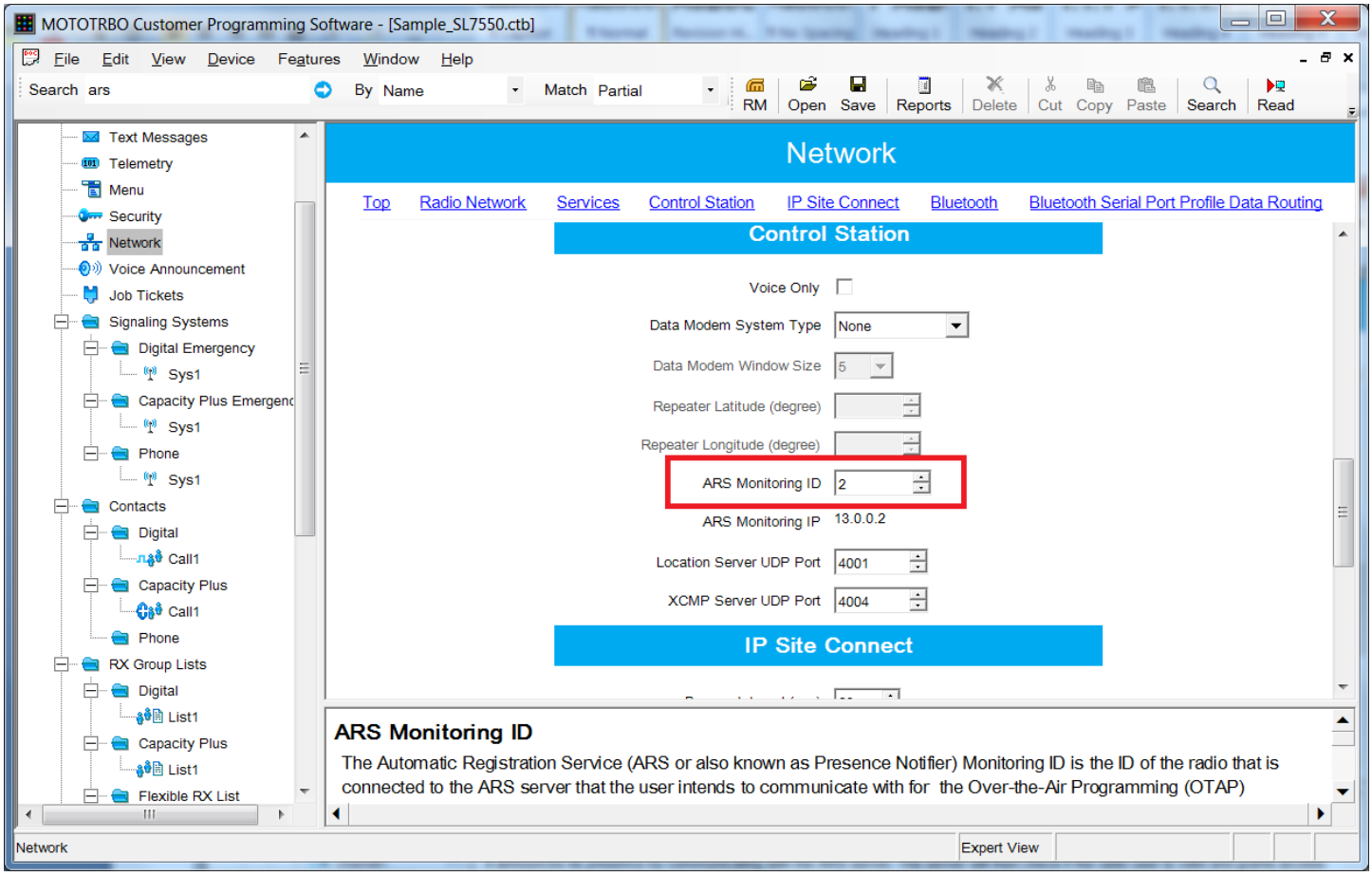

Figure 4-3 – ARS Monitoring ID

Sign In / Sign Out Enable.

If the user signs-in successfully, the sign out will be shown in main menu instead. The Sign In/ Sign Out state messages are sent from radio to ARS server and follow the standard protocol of ARS User Registration/Deregistration Message. For details, refer to section 3.4.7 ARS User Registration Message - section 3.4.11 ARS User Deregistration Acknowledgement.

DDMS is responsible to acknowledge the radio sign-in/out message in this feature. When DDMS receive the sign in request from subscriber, it needs to verify if the user ID in the login request is a valid user or not. Thus DDMS will send an authentication request message to authentication server which is a separate application to validate the user ID. The Authentication Server is required to send back the Authentication Reply Message after checking the user ID in its database. All the 3rd party applications who interested the radio user Sign in/Sign Out state need subscribe Sign In/Sign Out messages first, which is the same as Interface between Data application and ARS Server in section 2.2. For DDMS to Watcher Interface and MSCs in detail, refer to [5].

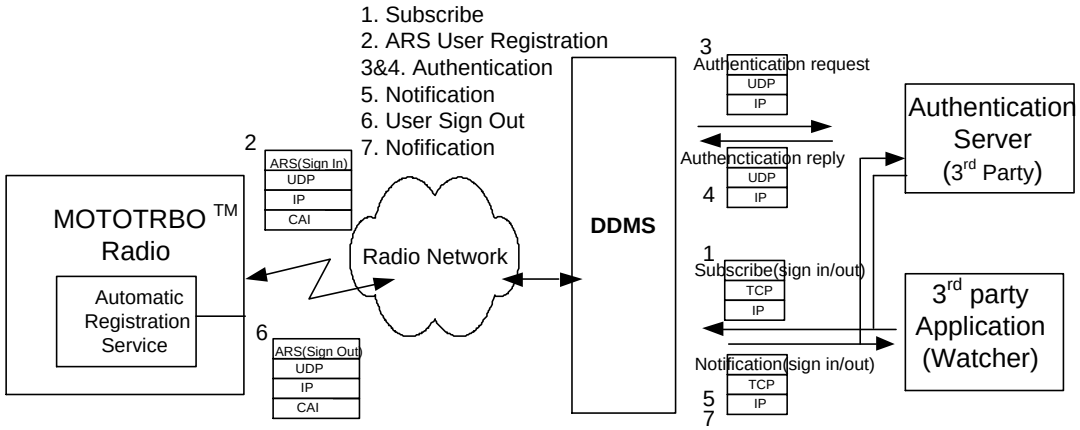

Figure 2-6 – Sign In / Sign Out Using the DDMS

3 Protocol Definition

3.1 PDU Structure

The ARS PDUs consist of a common header structure followed by the ARS specific elements. The basic structure of all ARS PDUs is shown in the following figure.

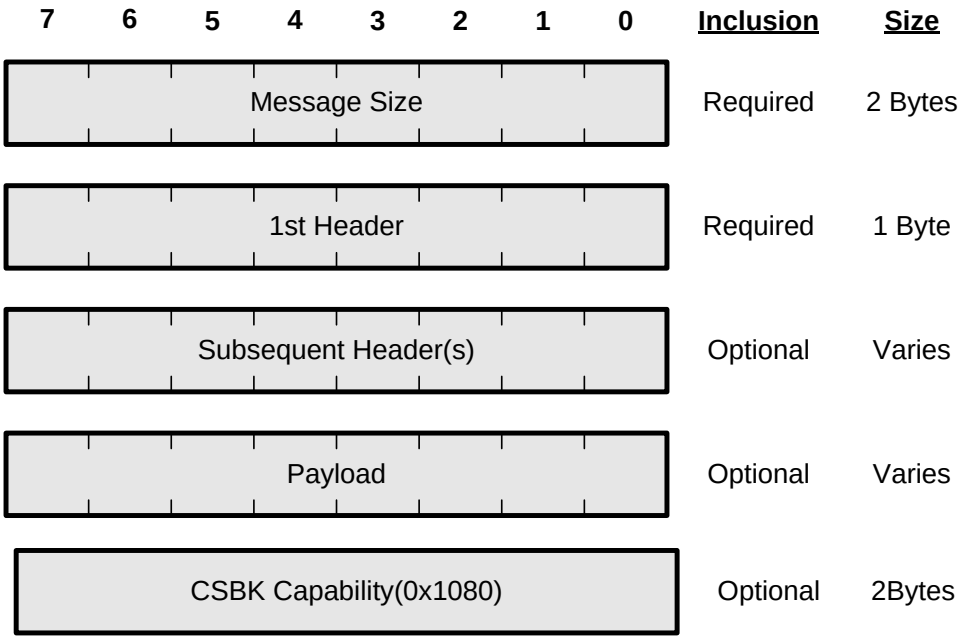

Figure 3-1 – ARS Protocol Message Structure

The fields are defined as follows:

- **Message Size (Always Present)** – This indicates the number of bytes to follow. The size DOES NOT include the two Message Size bytes.
- **First Header (Always Present)** – This header includes basic information such as the PDU type.
- **Subsequent Header(s) (Depends on PDU Type)** – Includes additional information specific to the PDU Type.
- **Payload (Depends on PDU Type)** – This includes any PDU specific payload information.

3.2 Header Bit Definitions

The following figure shows the bit definition in each box of the header.

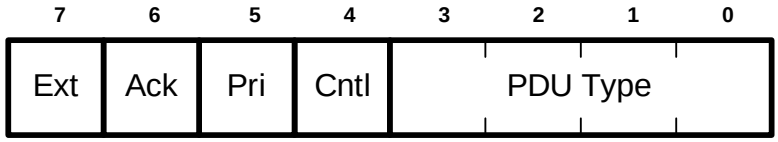

Figure 3-2 – 1st Header Bit Definitions

The setting of each bit shall depend on different application scenarios. The following shall describe their functionalities of each bit at different conditions.

1. Header Byte 1 (Always Present)
   - Extension Bit (Ext) – If this bit is set, there are additional or optional header byte(s) that further define the message.
     - Required headers are not specified by the use of this bit but are implied in the definition of the PDU.
     - If the use of an optional header is required, the PDU must include all optional headers that occur before that header.
   - Acknowledgement Required / Acknowledgement Failure (Ack) – The use of this bit depends upon the PDU itself. For the purposes of this bit, the PDU is considered an acknowledgement PDU or a non-acknowledgement PDU.
     - Non-Acknowledgement PDU - If this bit is set, it indicates that the initiator is requesting an acknowledgement to this PDU.
     - Acknowledgement PDU – If this bit is clear, this acknowledge indicates a success of the respective request. If this bit is set, this acknowledgement indicates the failure of the request.
   - Priority – This bit indicate the relative priority of the PDU.
     - 1 is high, 0 is normal.
     - In general, all control PDUs are high priority.
   - Control/User Bit (Cntl) – If this bit is set, it indicates that this is a control message for the protocol. The protocol layer uses control messages to exchange information with its peer. If this bit is clear, this is user data. For example, text message.
   - PDU Type – Defines the PDU Type. Types are associated with the control/user setting. For example, there may be a PDU Type 0 for control and a PDU Type 0 for user data.
2. Header Byte X (Optional, X>1, Dependent on Ext setting of byte X-1)
   - Extension Bit (Ext) – If this bit is set, there is another optional byte that follows which further defines the type. This means, the 2nd byte which defines header byte shall follow the extension.

Notes:

- The Address field is not used for the ARS protocol messages, so the Address Size field is always set to 0.
- Header extension bytes that are optional must follow the defined order. If optional header byte (3) is required, then header byte (2) must be present.
- If a generic failure is received, for example an acknowledgement with the Acknowledgement Failure bit set, and optional extension headers were included, the initiator of the message may retry the message without the use of extension headers. This will act as a “lowest common denominator” for the protocol.
- Any PDU types that are not understood should be ignored.

3.3 CSBK Capability Definition

The following figure shows the bit definition in CSBK Capability Fields.

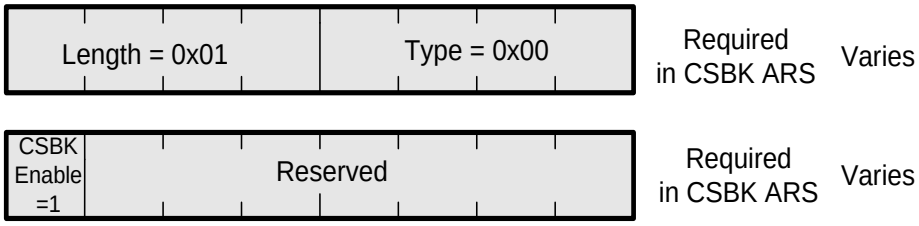

Figure 3-3 – CSBK Capability Structure

The CSBK ARS feature is applicable when using the CSBK data feature. CSBK Capability Fields are only available when the CSBK data feature is enabled in CPS. For details, refer to [4].

CSBK ARS message has the same message sequences and same message format with 2 extra bytes (0x1080) appended to the end of message in contrast to standard ARS messages.

3.4 ARS Protocol Messages

This section defines the ARS protocol messages. The ARS protocol does not define any user messages.

3.4.1 ARS Device Registration Message

This message is used to register a device with the ARS server.

1. Headers
   - First Header Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	1	Set to 1 to request acknowledgement
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0000	Type code for this message

   - Second Header Byte (Optional)

     The second header specifies the encoding of the non-size portions of the payload. If the second header is not present, the encoding is UTF8.

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-5	Event	Varies	Further qualifies the registration. • 0x01 – Initial Event • 0x10 – Refresh Event
4-0	Encoding	00000	Indicates the encoding of the non-size portions of the payload (name field). • %00000 (UTF8)

2. Payload

   The payload of the registration message contains the name field. The field is Length-Value encoded. If a particular portion of the name field is not used, the associated length should be set to zero.

   The format of the name field is as follows:

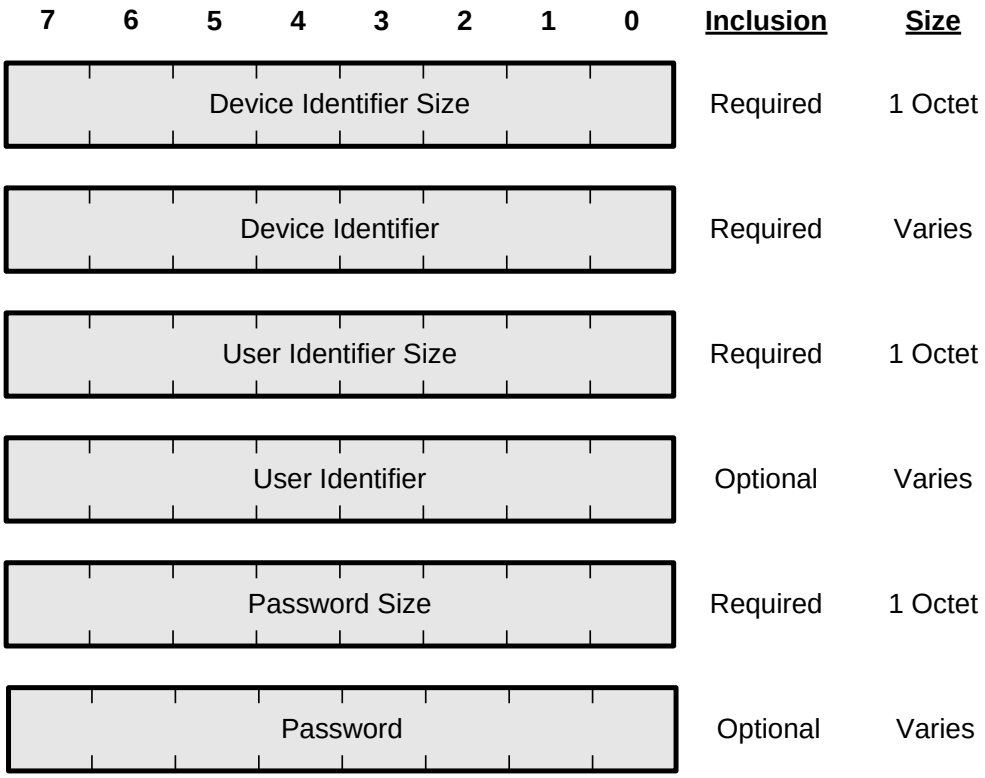

Figure 3-4 – ARS Protocol Message Structure for Name Field

The size indicates the number of characters based on the encoding scheme. The Device Identifier field is set as the SU ID. The User Identifier and Password fields are not used, so the User Identifier Size and Password Size fields are set to 0. For example, for a SU with ID of 11, the payload data is 0x02 0x31 0x31 0x00 0x00.

3.4.2 ARS Device Registration Acknowledgement (Success)

This message is used to positively acknowledge an ARS device registration message. Optional headers are used to convey the Refresh Timer value and the Session Timer value to be used by the subscriber.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	0	Clear to 0 to indicate successful ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	1111	Type code for this message

- Second Byte (Optional)

The second header specifies the refresh timer value to be used by the subscriber. If this header is not present, then the subscriber must use a refresh time value of zero (disabled).

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-0	Refresh Time	Varies	• 1 unit == 30 mins • Default: 0 == disabled, no refresh required • Range: [%1, %1111111] , 30mins to approx. 2.5 days

2. Payload

None.

3.4.3 ARS Device Registration Acknowledgement (Failure)

This message is used to negatively acknowledge an ARS device registration message. An optional header is used to convey the reason for the failure.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	1	Set to 1 to indicate a failed ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	1111	Type code for this message

- Second Byte (Optional)

The second header specifies additional information to further qualify the failure.

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-0	Failure Reason	Varies	%0000000 – Device not authorized for service.

2. Payload

None.

3.4.4 ARS Device Deregistration Message

This message is used to deregister a device from the ARS server. Note that if the device is deregistered from the ARS Server, the user is also deregistered from the ARS Server.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional header to follow
6	Acknowledgement	0	Clear to 0, no acknowledgement required
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0001	Type code for this message

2. Payload

None.

3.4.5 ARS Query Message

This message is used to query a specific subscriber. If the subscriber is ARS registered, it will respond with a simple acknowledgement.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional header to follow
6	Acknowledgement	1	Set to 1 to request acknowledgement
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0100	Type code for this message

2. Payload

None.

3.4.6 ARS Query Acknowledgement

This is a simple header used to respond to a query request.

1. Headers

   First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional header to follow
6	Acknowledgement	0	Clear to 0 to indicate successful ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	1111	Type code for this message

2. Payload

   None.

3.4.7 ARS User Registration Message

This message is used to register a user with the ARS server.

1. Headers
   - First Header Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	1	Set to 1 to request acknowledgement
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0101	Type code for this message

- Second Header Byte (Optional)

The second header specifies the encoding of the non-size portions of the payload. If the second header is not present, the encoding is UTF8.

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-5	Event	XX	Don't care
4-0	Encoding	00000	Indicates the encoding of the non-size portions of the payload (name field). • %00000 (UTF8)

2. Payload

The payload of the registration message contains the name field. The field is Length-Value encoded. If a particular portion of the name field is not used, the associated length should be set to zero.

The format of the name field is as follows:

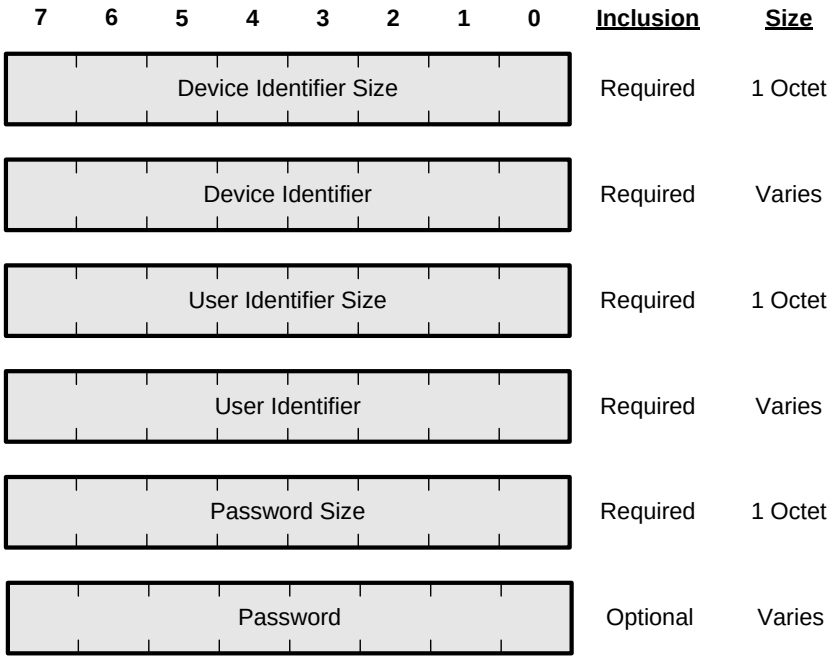

Figure 3-5 – ARS Protocol Structure for Name Field

- Example

  The radio ID is 11 and the user ID is 999999999.

  0x 00 10 F5 00 02 31 31 09 39 39 39 39 39 39 39 39 00

3.4.8 ARS User Registration Acknowledgement (Success)

This message is used to positively acknowledge an ARS user registration message. An optional header is used to convey the Session Timer value to be used by the subscriber. If the optional Session Timer header is not included, the user session will expire when the refresh timer expires.The message shall be fixed as 0x 00 02 B7 00.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	0	Clear to 0 to indicate successful ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0111	Type code for this message

   - Second Byte (Optional)

     The second header specifies the refresh timer value to be used by the subscriber. If this header is not present, the subscriber should use a default refresh timer value of zero (disabled).

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-0	Session Time	0000000	0 means session is valid until radio is power cycled

2. Payload

   None.

3.4.9 ARS User Registration Acknowledgement (Failure)

This message is used to negatively acknowledge an ARS user registration message. An optional header is used to convey the reason for the failure.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	Varies	Set to 1 if the second header is present
6	Acknowledgement	1	Set to 1 to indicate a failed ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0111	Type code for this message

   - Second Byte (Optional)

     The second header specifies additional information to further qualify the failure.

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional headers to follow
6-0	Failure Reason	Varies	Failure Reason: • 0x01 – User Validation Failed – User ID is not valid • 0x02 – User Validation Timeout – DDMS did not receive response from the User Authentication App within 30s. • All other values are considered transmission failure

2. Payload

   None.

3.4.10 ARS User Deregistration Message

This message is used to deregister a user from the ARS server. Note that this message does not deregister the device from the ARS Server.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 0, no other optional header to follow
6	Acknowledgement	1	Set to 1 to request acknowledgement
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0110	Type code for this message

2. Payload

   None.

3.4.11 ARS User Deregistration Acknowledgement

This message is used to positively acknowledge an ARS user deregistration message.

1. Headers
   - First Byte (Required)

Bit(s)	Field	Value	Notes
7	Extension	0	Clear to 1 to indicate no second header
6	Acknowledgement	0	Clear to 0 to indicate successful ACK
5	Priority	1	Set to 1 to indicate high priority
4	Control/User	1	Set to 1 to indicate Control message type
3-0	PDU Type	0111	Type code for this message

2. Payload

   None.

4 CPS Provisioning

4.1 ARS Enable

The “ARS Enable” is to indicate whether the ARS feature is enabled or not in a specific personality. It is a Personality-Wide configuration. If the ARS feature is “on system change”, it means when radio powers up on this personality or mode change to this personality, radio will initiate a device registration message to the ARS server. If the ARS feature is “on system/site change” and IP Site Connect is enabled at this channel, it means when radio powers up, roaming to another site on this personality or mode change to this personality, radio will initiate a device registration message to the ARS server.

Note: The ARS feature is only available when the MOTOTRBO™ radio is operating in digital mode. For analog personality, this parameter is always disabled and not allowed to change the setting by CPS.

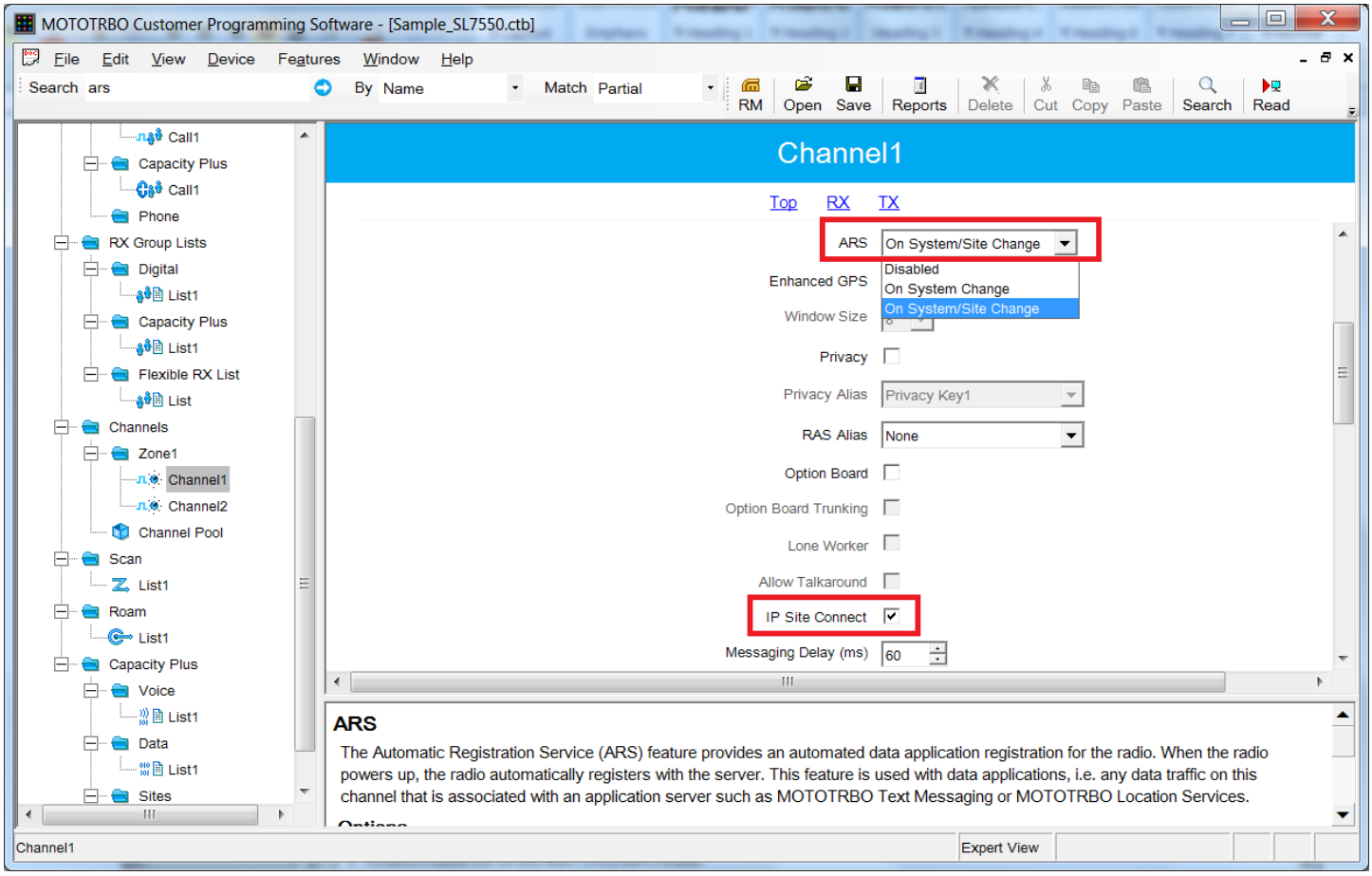

Figure 4-1 – ARS Enable Configuration

4.2 ARS Radio ID and ARS Monitoring ID

The “ARS Radio ID” and “ARS Monitoring ID” are both ARS related fields but for different purposes. If there is only one ARS server in the system, the ARS Monitor ID shall not be set in the control station nor in any of the field radios. Configuring the ARS Monitor ID in the field radios will cause the flooding of the ARS messages in the system. For details, refer to [7].

The “ARS Radio ID” is the ID of the radio that is connected to the ARS server that the user intends to communicate with for data services.

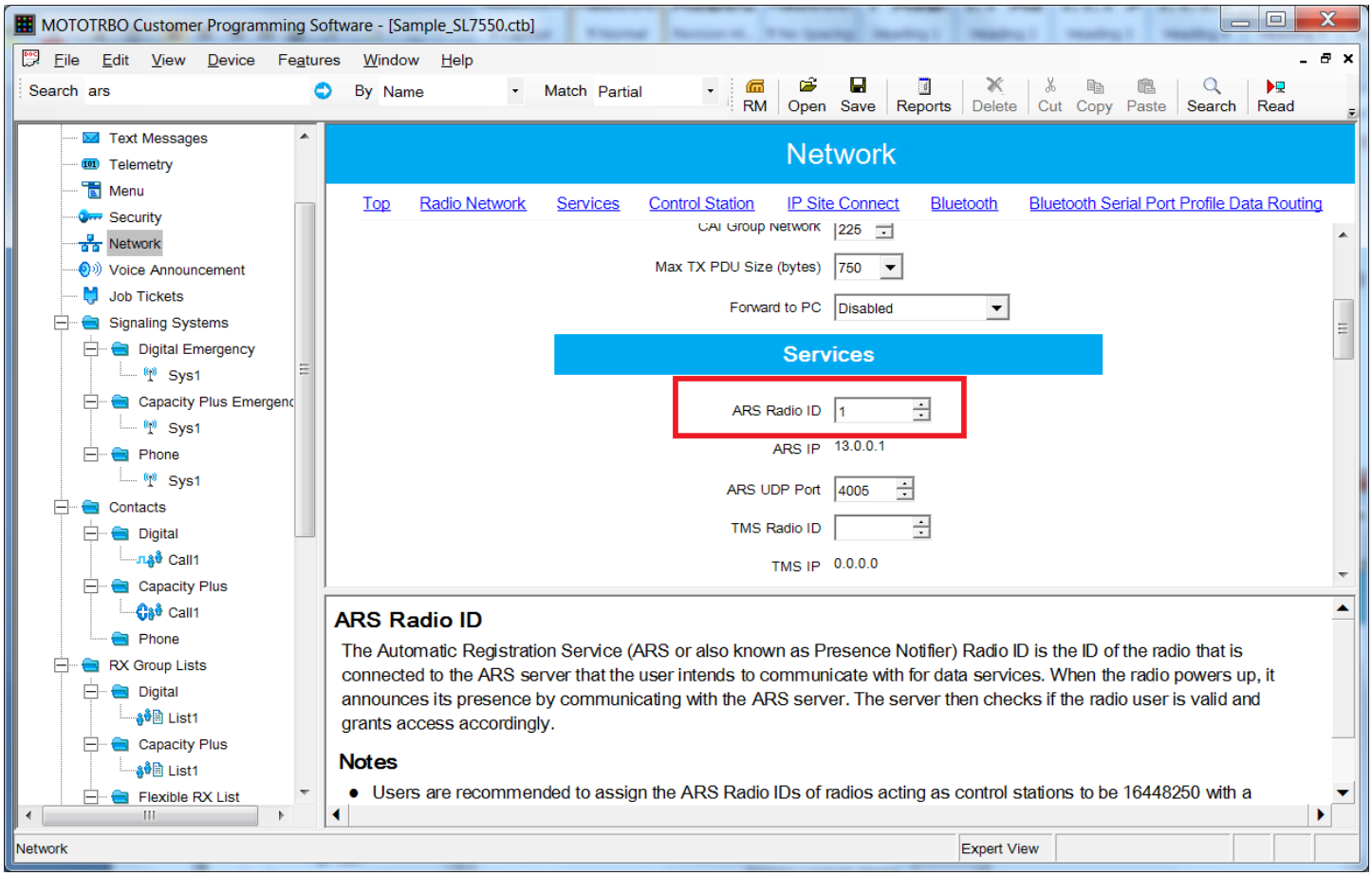

Figure 4-2 – ARS Radio ID

The “ARS Monitoring ID” is the ID of the radio that is connected to the ARS server that the user intends to communicate with for the Over-the-Air Programming (OTAP) services. If the ARS Monitor ID is configured in the control station, the control station will not send the layer 2 confirmation for the ARS message, however it will still pass the ARS message to the connected server. The connected server interfacing to the control station shall not send the layer 7 ARS message acknowledgement.

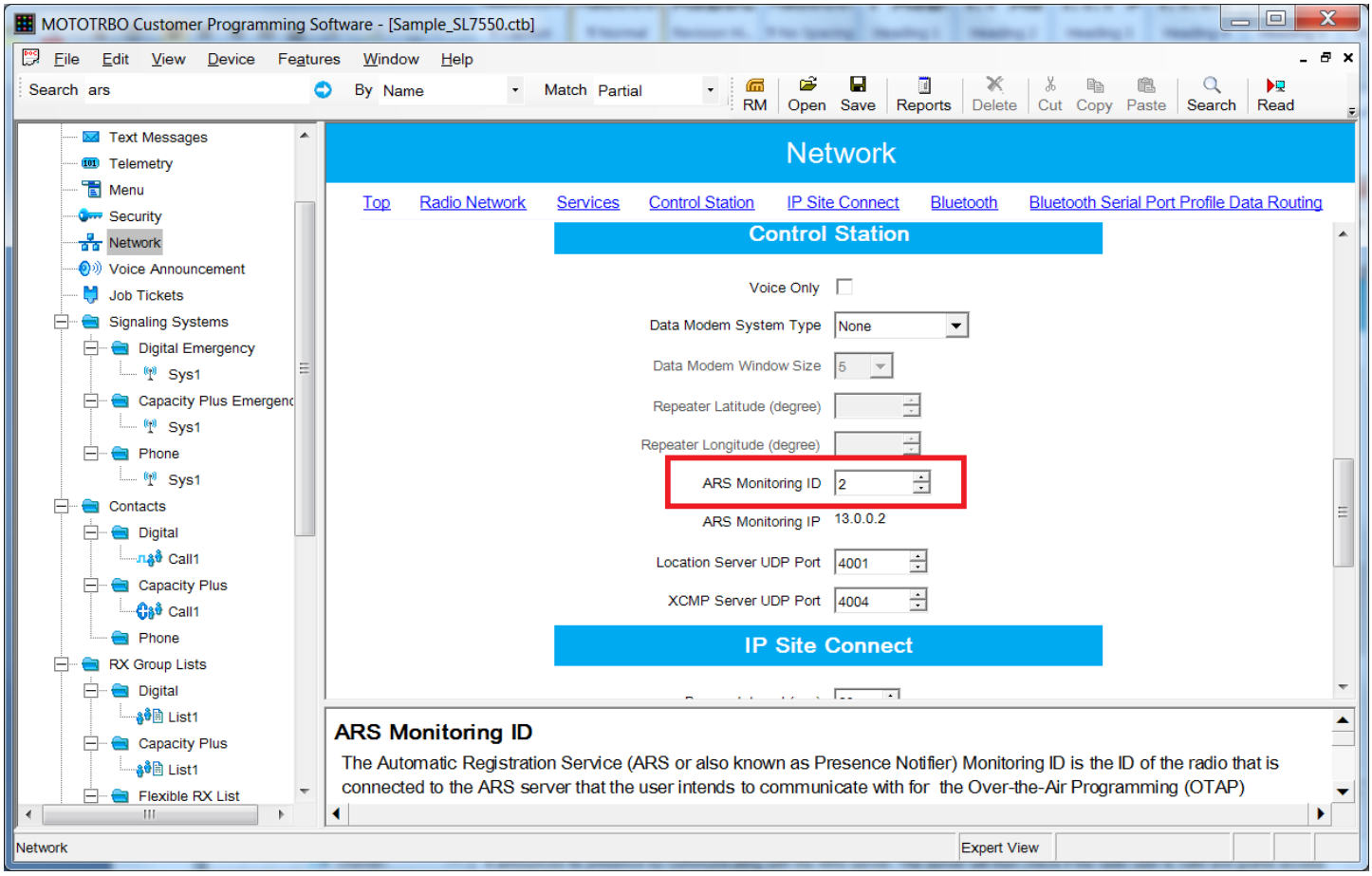

Figure 4-3 – ARS Monitoring ID

4.3 Sign In / Sign Out Enable

The “Sign In / Sign Out Enable” is to indicate whether the Sign In / Sign Out feature is enabled or not in a radio wide configuration. This feature shows an indication whether the user has signed into the third-party server or not on the home screen of the radio. The sign-in information is kept until the radio powers down or the user signs out manually.

Note: The Sign In / Sign Out feature is only available when the MOTOTRBO™ radio is operating in digital mode. This feature is independent with ARS enable in personality wide configuration.

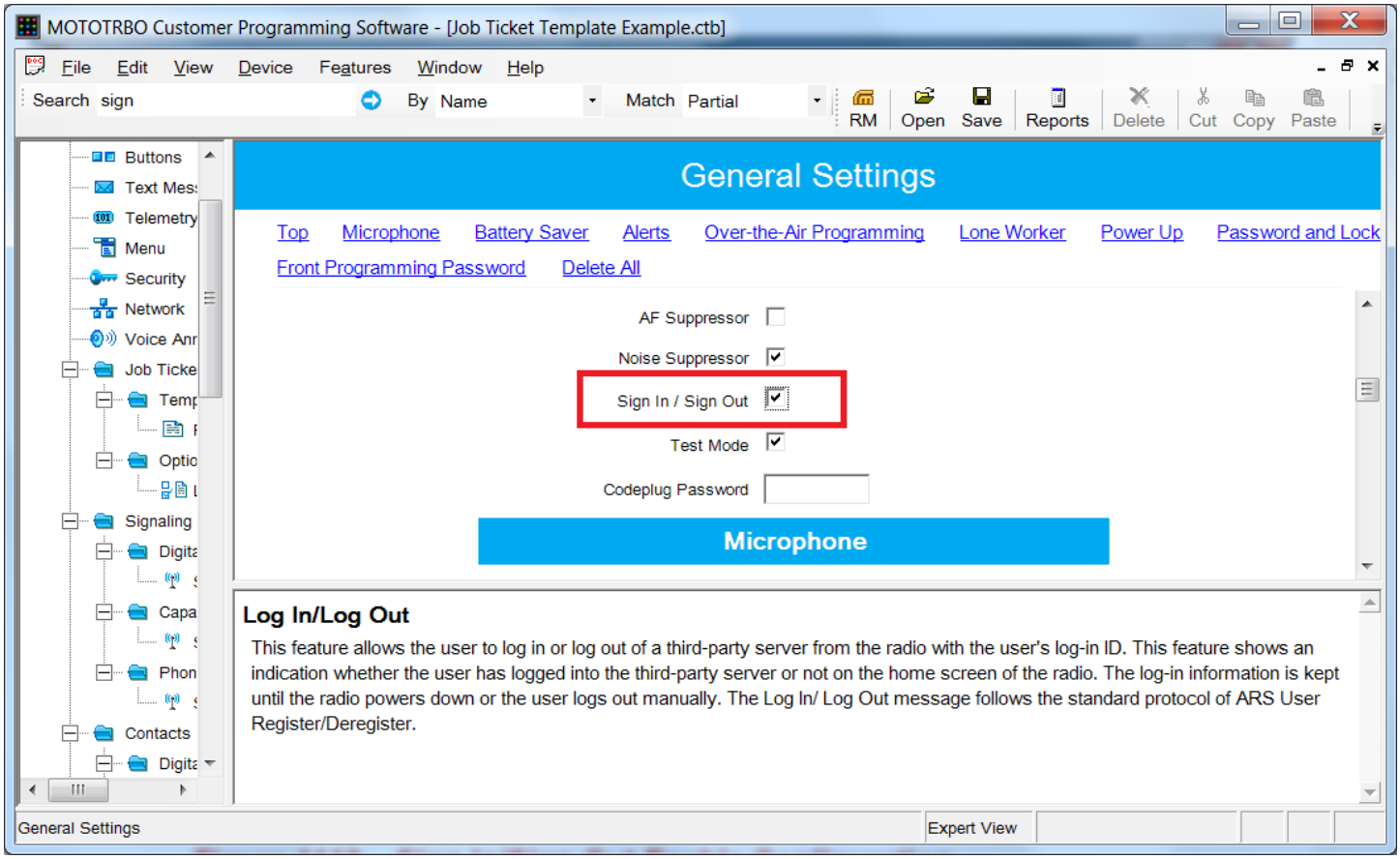

Figure 4-4 – Sign In / Sign Out Enable Configuration

4.4 IP and UDP Configuration

The transport layer between MOTOTRBO™ radio and the ARS Server is UDP/IP. So we shall configure the IP address and UDP port for both MOTOTRBO™ radio and the ARS Server. The figure below shows the communication between the SU and ARS Server.

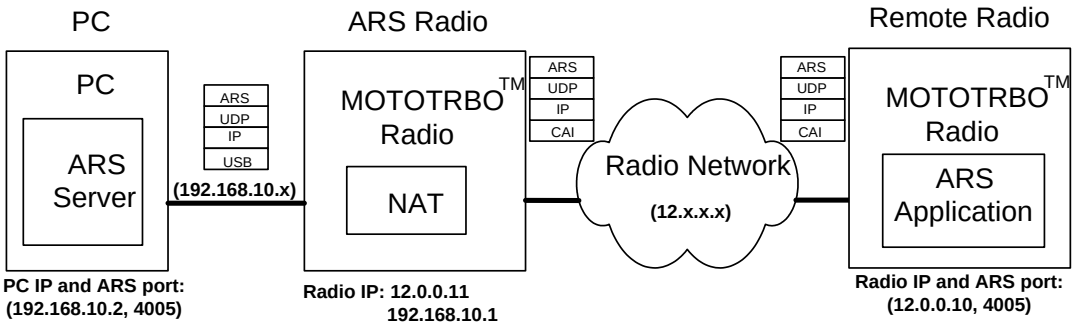

Figure 4-5 – Communication between the SU and ARS Server

The ARS Server communicates with the remote radio via the ARS Radio, so there are two IP network segments. One is PC to ARS Radio segment and the other is ARS Radio to Remote Radio segment. Private IP address is used in the PC to ARS Radio network segment, or generally it is 192.168.10.x. This private IP address is transparent to the remote radio because the ARS Radio will do network address translation for the message that is sent to remote radio by PC.

4.4.1 Radio IP Address

The Radio has two IP addresses, one is for the CAI radio network, and the other is for the private radio network (PC network). Both the IP addresses can be configured by CPS.

To configure the private radio network IP address, set the Radio IP field via CPS. For example, in Figure 10, it is set as 192.168.10.1.

The CAI radio network IP address consists of two parts: the CAI Network ID and the Radio ID. The Network ID is the “Network ID” of the IP address of a radio and the Subscriber ID is the “Host Number” of the IP address of a radio. For example, in Figure 10, the CAI Network is 12 and the Radio ID is 10, then the IP address of the radio is 12.0.0.10. If you want to know more detail about the Radio IP address derivation, please refer to reference [4] in section 1.6.

When the remote radio sends an ARS message to the ARS Server, the CAI radio network IP address is used as the source IP address of the message.

4.4.2 4.2.2 Radio ARS UDP Port

The Radio ARS UDP Port is always 4005 and is not CPS configurable.

4.4.3 ARS Server IP Address

The ARS server running on a PC is connected to the ARS Radio. Based on the IP address assignment schema, the PC as the radio's accessory will have the same Host Number of the ARS Radio, and its Network ID is the Network ID of the ARS Radio + 1. So the ARS Radio ID has to be configured. In the figure below, the CAI network ID is 12 and the ARS Radio ID is 11, so the ARS IP is 13.0.0.11. Please see reference [4], in section 1.6, for more detail on the IP address assignment schema.

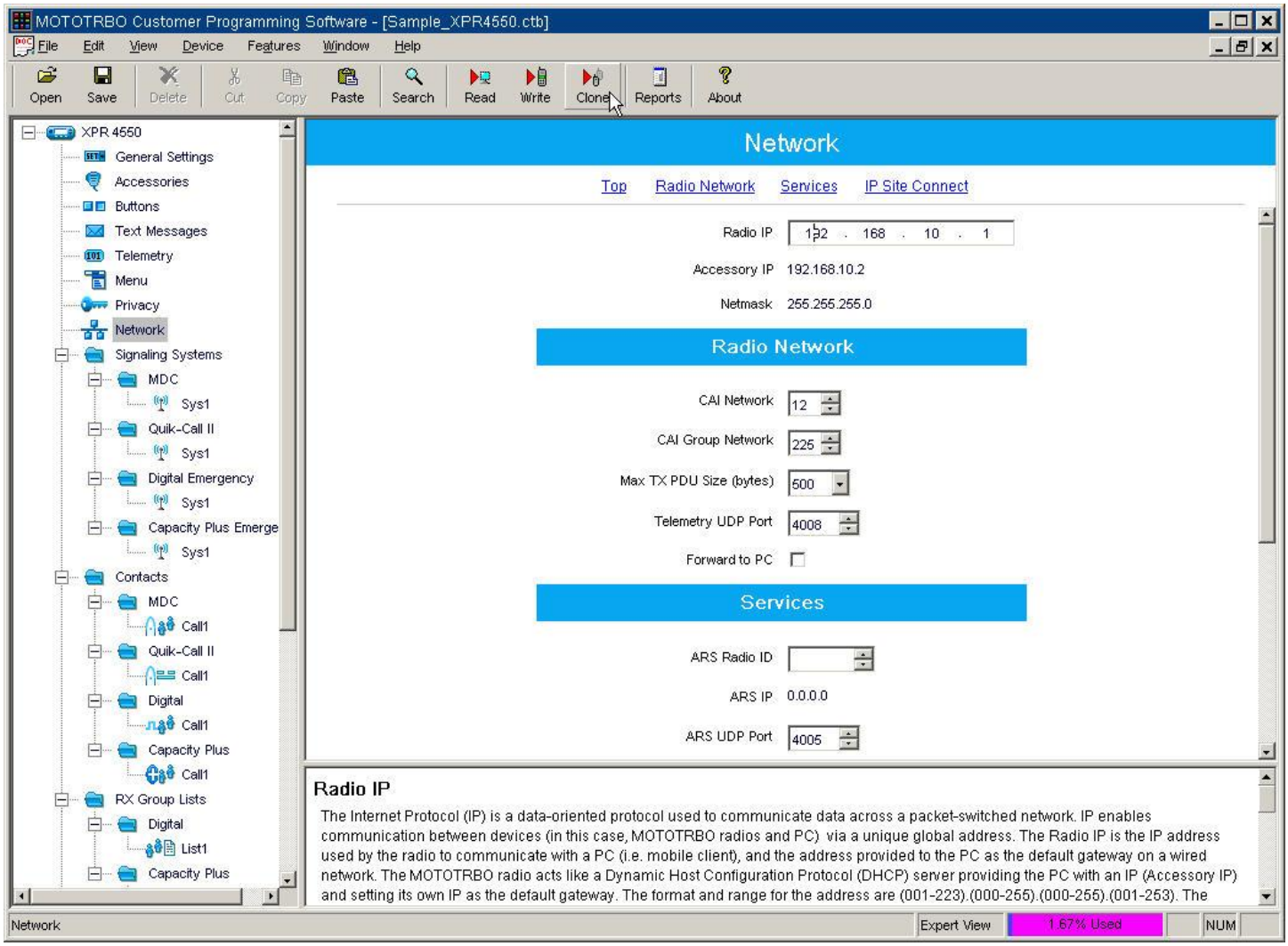

Figure 4-6 – Radio and Server IP Address Configuration

According to the configuration in Figure 10, when the remote radio sends an ARS message to the ARS Server, the source IP address is 12.0.0.10, and the destination IP address is 13.0.0.11. And when the ARS Radio receives this ARS message, it will translate the destination IP address as the private IP address, for example 192.168.10.2, and then forward it to the ARS Server.

4.4.4 ARS Server UDP Port

The Automatic Registration Service (ARS) UDP Port specifies a dedicated port number for the ARS Server to enable communication between the ARS client and ARS server.

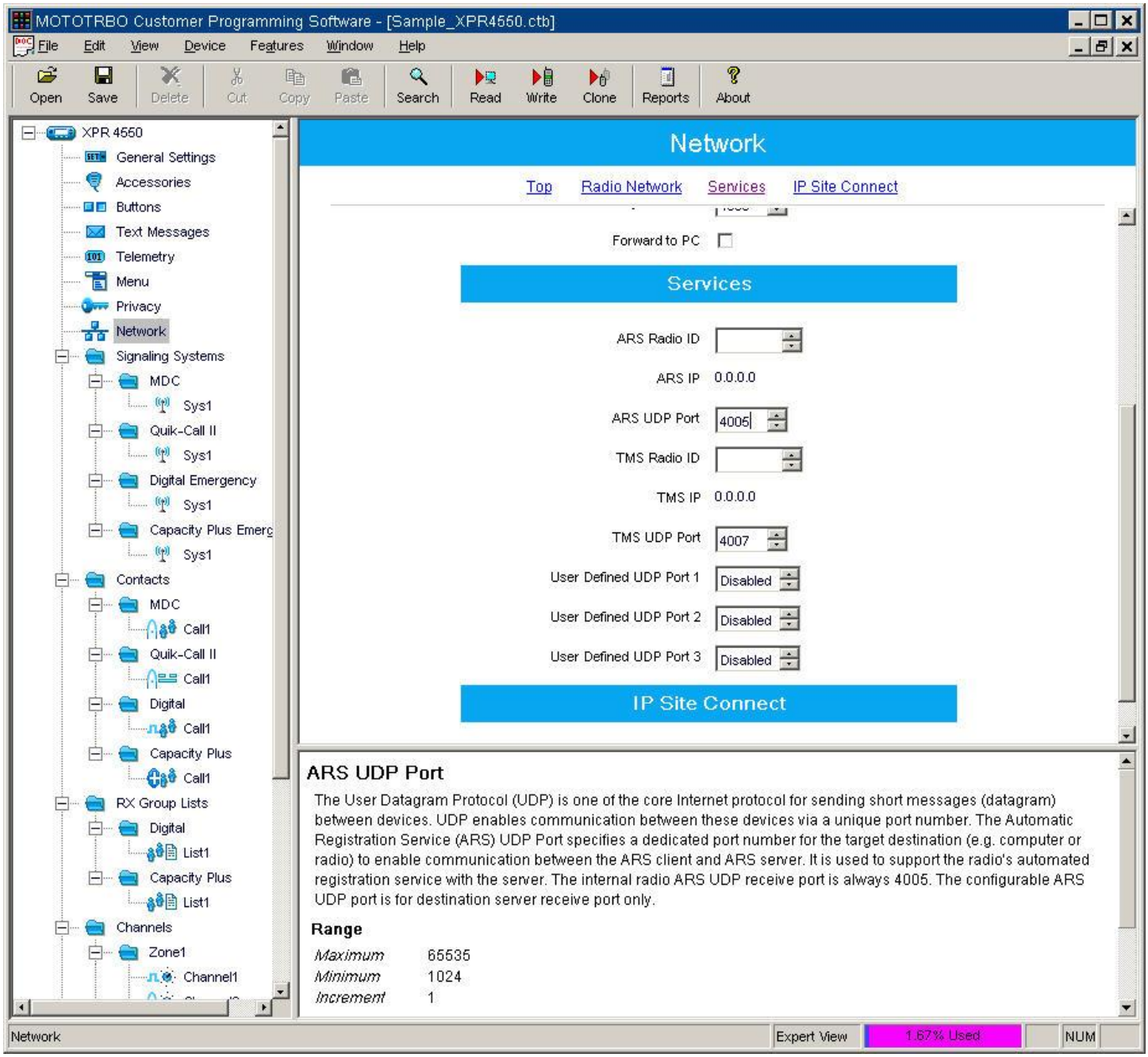

Figure 4-7 – ARS Server UDP Port Configuration

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Revision History

Version	Date	Page	Section	Lines	Notes
02.00	05/01/2014	2-2, 2-7 3-8~3-12 4-2 4-3	2.2 2.6 3.4.7- 3.4.11 4.2 4.3		Add sign in /sign out feature for R2.3A. Add DDMS relationship with ARS server. Add ARS monitoring CPS configuration.
01.08	10/16/2013	3.1 3.3	3 14 16 17	276 343-352	Add CSBK ARS feature for R2.3
01.07	08/24/2012	2.3.1	9	162-164	ADK_ENH: clarify ARS retry timer **(CCMPD01472698)**
01.06	02/17/2011	2.1 2.2 2.3.1 2.3.3	7 8 9 11	93 131 158 213	Implement the Automatic Register Service on Roaming Feature (CCMPD01452679)

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